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ABSTRACT

In the project described in this paper, the synthesis of research into situated learning was used to design and develop a multimedia learning environment to teach assessment strategies in mathematics to preservice teachers which was intended to transfer to teaching practice. The paper describes a follow-up study which investigated the influence of using the authentic approaches presented in the multimedia learning environment on the teaching and assessment practices of the same people as beginning teachers. Practicing teachers, who as preservice teachers participated in the earlier study, were interviewed with regard to the influence that the authentic approach had on their first and second years of teaching and assessing mathematics. Analysis of data indicates that a complex mix of influences and environmental factors impact upon the teachers' use of assessment strategies in their beginning years of teaching, and that preservice pedagogical beliefs are not always translated to beginning classroom practice. (Author)

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AUTHENTIC APPROACHES TO LEARNING ASSESSMENT STRATEGIES: BEGINNING TEACHERS' PRACTICE IN CLASSROOMS

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In the project described in this paper, the synthesis of research into situated learning was used to design and develop a multimedia learning environment to teach assessment strategies in mathematics to preservice teachers which was intended to transfer to teaching practice. The paper describes a follow-up studywhich investigated the influence of using the authentic approaches presented in the multimedia learning environment on the teaching and assessment practices of the same people as beginning teachers. Practicing teachers, who as preservice teachers participated in the earlier study, were interviewed with regard to the influence that the authentic approach had on their first and second years of teaching and assessing mathematics. Analysis of data indicates that a complex mix of influences and environmental factors impact upon the teachers' use of assessment strategies in their beginning years of teaching, and that preservice pedagogical beliefs are not always translated to beginning classroom practice.

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Introduction

The persistent failure of beginning teachers to access pedagogical skills and strategies acquired during teacher training is an ongoing problem for teacher educators throughout the world. In mathematics, despite the variety of strategies recommended, the *Third International Mathematics and Science Study* indicated that teachers generally continue to limit their approaches to traditional methods (Lokan, Ford & Greenwood, 1996). Traditional classroom approaches reflect a view of mathematics as a set of discrete, hierarchically arranged facts and skills; a view of learning mathematics as replication and repetition; a view of teaching mathematics as exposition and practice; and a view of assessing mathematics as paper and pencil testing for the sole purpose of grading and ranking (Niss, 1993; Stephens, 1992). This lack of progress may result from ineffective teacher-training courses (Borko, et al., 1992). Even newly-trained teachers with non-traditional beliefs about mathematics teaching and learning return to traditional teaching approaches (Brown & Borko, 1992; Raymond, 1997).

One reason for the long-term ineffective practical outcomes of such university courses, is according to Resnick (1987), a result of too little engagement with genuine situations, and too much emphasis on theoretical perspectives. Genuine situations such as school practice, may enable some student teachers to experience classrooms which reflect curriculum reform. For many, however, their school practicum experience is often a reaffirmation of the traditional approaches that are already ingrained from their

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own schooling (Comiti & Ball, 1996). For those who do observe and engage with teachers using current approaches, the extent and range of approaches seen is limited to a few—the ones with which their supervising teachers are familiar and comfortable implementing. One way to align university teaching and learning more substantially with the way learning is achieved in real-life settings is to base instructional methods on more recent theories of learning which reflect this shift, such as *situated learning* (e.g., Brown, Collins, & Duguid, 1989; Collins, Brown, & Newman, 1989; Lave & Wenger, 1991; McLellan, 1996). Collins (1988) defines situated learning as: 'the notion of learning knowledge and skills in contexts that reflect the way the knowledge will be useful in real life' (p. 2).

Nine critical characteristics of situated learning environments were defined from the extensive literature on the subject and used to inform the instructional design of learning environments (described in detail in Herrington & Oliver, 2000). The learning environment, in reflecting a situated learning approach, needed to:

- provide an authentic context that reflects the way the knowledge will be used in real-life;
- provide authentic activities;
- provide access to expert performances and the modelling of processes;
- provide multiple roles and perspectives;
- support collaborative construction of knowledge;
- provide coaching and scaffolding at critical times;
- promote reflection to enable abstractions to be formed;
- promote articulation to enable tacit knowledge to be made explicit; and
- provide for integrated assessment of learning.

A multimedia program was developed to enable teachers and pre-service teachers of mathematics to explore issues of assessment, entitled *Investigating Assessment Strategies in Mathematics Classrooms* (Herrington, Sparrow, Herrington, & Oliver, 1997). Twenty three assessment strategies suitable for use in K-12 classrooms were identified and grouped in the following categories: *Questioning, Interviewing, Testing, Problem solving, Reporting* and *Self-assessment,* and presented in a multimedia format. Five complex, authentic activities were designed consisting of memos and other documents, to enable students to explore the resource within the parameters and constraints of a realistic task. The interface (see Figure 1) simulates the front part of a classroom with the resources represented by appropriate metaphors (such as video cassettes, filing cabinet drawers, folders on the desk) giving direct access to the following resources:

1) Video clips of teachers using various assessment techniques
2) Video clips of teachers' comments on the strategies

3) Video clips of children's comments on the strategies to present their own thoughts

4) Interviews with experts in the field to provide theoretical perspectives

5) Reflections by third year preservice teachers to provide practical advice

6) Text descriptions of each assessment category

7) Teachers' resources and children's work samples

8) An electronic notebook to enable students to copy text and to write their own ideas

9) Problems and investigations to enable the students to complete authentic tasks.

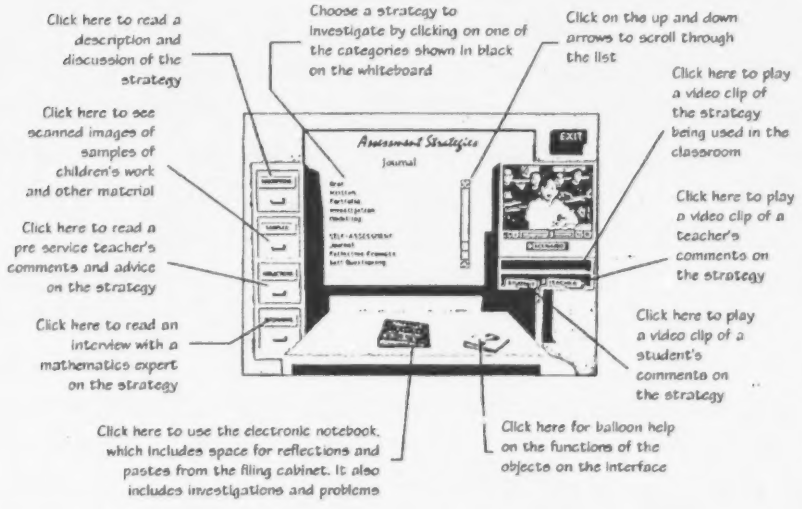
Click here to read a description and discussion of the strategy
Choose a strategy to investigate by clicking on one of the categories shown in black on the whiteboard
Click on the up and down arrows to scroll through the list
Click here to play a video clip of the strategy being used in the classroom
Click here to see scanned images of samples of children's work and other material
Click here to play a video clip of a teacher's comments on the strategy
Click here to read a pre service teacher's comments and advice on the strategy
Click here to read an interview with a mathematics expert on the strategy
Click here to play a video clip of a student's comments on the strategy
Click here to use the electronic notebook, which includes space for reflections and pastes from the filing cabinet. It also includes investigations and problems
Click here for balloon help on the functions of the objects on the interface
Assessment Strategies
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Figure 1. The interface of *Investigating Assessment Strategies in Mathematics Classrooms* showing constitutive elements.

In the first study, preservice teachers explored a variety of assessment strategies appropriate to K-12 mathematics classrooms using the multimedia assessment program. The students spent three weeks of the semester examining strategies within the context of a complex and sustained authentic activity, where in small collaborative groups, they prepared and presented a report on a new assessment plan for mathematics in a school. In order to do this, they were asked to consult with experts, look at what

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was happening in classrooms, talk to teachers, talk to students and so on—all of which could be done 'virtually' from the CD-ROM.

Three pairs of students were interviewed and observed as they used the multimedia program and the analysis of talk revealed that students used a substantial amount of higher-order thinking as they worked with the assessment program (reported in Herrington & Oliver, 1999). A study of the transfer of a variety of assessment strategies to classroom practice was conducted with the students as they completed two weeks professional practice in schools approximately five weeks after the completion of their work on the assessment program (reported in Herrington, Herrington, & Sparrow, 2000). All the students were required to teach mathematics classes in this practice, and it was expected that they would have the opportunity to implement different assessment strategies. Both students and supervising teachers in the schools were interviewed and the comments were transcribed and analyzed. Transfer was thought to have occurred if firstly, students using the interactive multimedia program on assessment had a good understanding of the types of assessment appropriate in the mathematics classroom and were able to articulate this understanding; and secondly, they employed a variety of the assessment techniques shown in the program, as opposed to the predominant use of pencil-and-paper tests (Cognition and Technology Group at Vanderbilt, 1993).

Analysis of the data shows that all the students could speak knowledgably and confidently about assessment, and all the students used a variety of techniques to assess children's understanding. As was expected, all were influenced strongly by the supervising teacher in the schools, many of whom had planned assessment in advance of the students' arrival. However, even when assessments had been planned in advance, all students used techniques that they were able to use without the contribution or agreement of the supervising teacher—such as checklists, anecdotal records and open interviews, which students could use individually with children as they circulated around classrooms. Five of the six students attributed their use of assessment techniques directly to the interactive multimedia program.

These very positive findings were qualified by two mitigating factors: the brevity of a two week professional practice and the substantial influence of the supervising teacher. In the words of one student: "I'm not the qualified teacher. I'm in their situation, in their room, conforming to their rules. So I can't just suddenly say 'Hey, let's do some oral assessment'".

Many of the students in the first study were inhibited in the choice of assessment strategies by the influence and authority of their supervising teachers, in a way which may not have been an issue if the students were practising teachers with their own classes. In order to investigate this issue further, a follow-up study of those students who had gained employment was carried out when the students were in the second year of teaching.

In the follow up study reported here, interviews were conducted with students from the first study who had gained employment as teachers. These four teachers were

in their second year of teaching, three in secondary schools Evie, Rowan and Zoe (pseudonyms used) and one in a primary school, Debra. Three teachers (two female, one male) were teaching mathematics in private schools in the metropolitan area of Perth, and one female, Evie, was teaching in a remote outback Government school in the north of Western Australia.

Participants were interviewed at their schools, for approximately 90-120 minutes each using an interview protocol described by Denzin (1989) as *a non-scheduled standardized interview*. Questions and probes were determined in advance, but there was flexibility in adjusting the interview protocol. Students were questioned about: their beliefs about assessment; their knowledge and use of assessment strategies in mathematics; the influence of school policy, colleagues, and national guidelines on their assessment practices; and the influence of their teacher training on their current practices. The interviews were recorded and transcribed for analysis. Transcripts of interviews were analyzed using techniques of qualitative analysis recommended by Miles and Huberman (1994) and Eisner (1991). Transcripts were summarized for each student and placed in a matrix that allowed comparisons to be made for each student's response to each interview question. A further summary of these responses is given below.

Results

Beliefs About Assessment

The secondary teachers felt that generally assessment practices had changed since they were at school with more emphasis on problem solving, investigations, and project work. Evie believed that many students had difficulties in adapting to different types of assessment, particularly those students that lacked motivation and showed poor attendance. She noted that open book exams had become a common practice at her school.

Zoe felt that the use of graphing calculators resulted in more conceptually based questions and was concerned about the lack of reliability of tests and grading. Rowan commented that there was too much testing in his school and would like to see more of an emphasis on investigations and problem solving with younger students.

Debra, a year one primary school teacher, enjoyed the use of varied approaches to understanding students and felt that there was less use of worksheets than when she had gone to school. She believed her assessment to be diagnostic identifying areas where individual children needed assistance.

Self Reported Assessment Practices

Two secondary teachers, Rowan and Zoe, reported that testing was used as their main form of assessment, ranging from multiple choice tests to conceptual tests using graphics calculators. They also indicated that they used group projects, posters and oral reports. The two other teachers, Evie and Debra, reported on using tests, observa-

tions, checklists, portfolios, projects and individual interviews. Debra and Rowan had used self assessment techniques where children reflected on their learning by drawing faces to express their understanding and by making review sheets for exams. Zoe indicated that she had tried using journals but found them unsuccessful because students found it difficult to give thoughtful reflections.

Perceived Influences on Assessment Practices

Debra relied heavily on the advice of a more experienced teacher and support from the Principal. Evie also felt that advice from colleagues was more helpful than professional development organized by the district office.

Zoe attributed her assessment approaches to mathematics education courses completed at university. However, the school had a policy of encouraging similar assessment strategies across grade levels which she indicated limited her use of alternative approaches.

All the teachers recalled having used the interactive multimedia in their mathematics education course and felt that it was a helpful and important resource – one with which they were able to learn about different forms of assessment in a collaborative and enjoyable way. Debra, in particular, felt that she would be able to find good use for the program now that she is teaching.

Discussion

In both studies the teachers appeared to have a sound understanding of alternative assessment strategies and ways in which they could be implemented. While the first study presented constraints in employing these strategies on professional practice, (such as limited time and the influence of the supervising teacher), as teachers they were also faced with cultural and practical constraints. Constraints include the requirements of the mathematics department in the school, State Curriculum guidelines, issues of practical classroom management, personal issues such as the amount of time that can be devoted to planning, and convictions about the suitability of certain types of assessment for certain students. As such, the teachers' pedagogical beliefs do not always translate to classroom practice.

Analysis of data indicates that a complex mix of influences and environmental factors impact upon the teachers' use of assessment strategies in their beginning teaching. For example, Zoe commenting on her practicum supervising teacher's use of assessment strategies in 1996, appeared to have a range of alternative strategies in mind which she failed to use in her teaching practice in 2000:

> *Interview with Zoe (1996):* It's opened my eyes a lot more ... and also watching my [supervising] teacher and really disagreeing with a lot of the assessment strategies he'd use. He only used pencil and paper assessment strategies. Of course I didn't say anything, but I'd sit there thinking 'Oh remember what we learnt'.

Interview with Zoe (2000): Testing. That's the main approach. With years 8, 9 and 10 mainly topic testing, and then at the end of their year we do an exam to get them ready for Year 11 and 12 ... If you put it on a piece of paper, you know if they can interpret it. I don't think that sort of testing is fantastic for every student ... but I can't think of another really appropriate assessment task.

The enthusiasm Evie had in 1996 to try a range of assessment strategies in her own classes, by 2000 had been overwhelmed by significant social and cultural problems:

Interview with Evie (1996): There were only limited types of assessment that I could use [on teaching practicum], but hopefully in the future I'll be able to use a wider range of the ones that were on the multimedia. Hopefully I'll be able to ... start journals and things like that.

Interview with Evie (2000): I'd like to vary a lot of things, such as I'd like to do a lot more collaborative work with the kids, group work. And probably even presentation type stuff, where kids can actually demonstrate or explain their findings, whether it be an investigation or even project work ... I just find that all these fantastic ideas that I come up with usually seem to backfire when I use them in the classroom. I don't see myself as being a really boring teacher ... [and] I'm not blaming it on the kids—but they just lack any self-motivation. And it's not just me ... all the learning areas are having the same problems with the same kids. I think the problem is they don't see the importance of education ... there is a high rate of kids dropping out, and girls falling pregnant at a young age which is really sad.

While the teachers' pedagogical beliefs do not always translate to classroom practice, this is not to conclude that teachers' beliefs about assessment revert to traditional beliefs. All the teachers in the study, when prompted on various assessment strategies indicated they had tried alternative approaches and that they would be willing to try these techniques in the future. One teacher indicated that she would try journals as an assessment strategy when she could better explain to the students how to keep them. The use of a situated learning environment (such as that provided on the CD-ROM) during teacher training may provide contextualised knowledge about assessment strategies but this knowledge will not necessarily be applied in teaching practice either as preservice or novice teachers because of intervening constraints. The scenarios aimed at developing pedagogical knowledge but did not directly focus on potential constraints that needed to be taken into account. This could be overcome by including these aspects as part of the problem that needed consideration, and could equally well be evident as teacher guidance when the student teachers discussed their solutions to the scenarios.

The apparently powerful social, cultural and environmental pressures with which new teachers must deal—pressures which cause many to revert to more traditional modes of teaching to deal with them— could also arguably be ameliorated by providing ongoing professional development. The professional development of beginning teachers is recognized as a necessary process in the long-term development of 'full-fledged professionals' (Schoenfeld, 2002, p. 22). Without support, these teachers can find it difficult to adapt to change, and can readily abandon approaches to teaching and learning emphasized in their university courses and current curriculum initiatives (Schoenfeld, 2002).

However, such support needs to be focussed. It is apparent the teachers in this study retained their pedagogical beliefs and practices that they had learnt during their university mathematics education course using the multimedia but were often constrained in applying this knowledge in the initial teaching environment. Professional development that simply revisits approaches encountered at university may well be ineffective because it does not address the range of constraints that are faced by novice teachers. On the other hand, novice teachers may benefit from support in *constraint management* where the problems of novice teachers could be aired and discussed in a similar way that could happen with preservice teachers. Rather than face to face discussion of potential problems, the Internet has the potential for providing a forum where constraints could be openly discussed and resolutions reached in a collegial environment.

Conclusion

The studies described in this paper have revealed an ongoing discrepancy between the preparation of teachers and the reality and demands of classroom teaching. The use of situated learning environments has gone a long way towards ameliorating the cognitive gap between theory and practice, but it has not been entirely successful (on its own) in promoting sustained transfer to the real teaching situation. Practical constraints and real-life restrictions on teachers' practice need to be accounted for more substantially and incorporated more fully into the situated learning model. Further research on these factors, and inservice professional development as described here, may help to ensure that pedagogically sound practice is learned, applied and sustained throughout teachers' professional life.

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